

AUG 17 2006

directly affect, be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1-36 are pending in the application and were originally presented in the application. Claims 1-36 stand rejected under 35 U.S.C. §103(a). The rejection of the pending claims is appealed. The pending claims are shown in the attached Appendix A.

Status of Amendments

The Examiner indicated the allowability of dependent claims 3, 15 and 30 in the Final Office Action. Therefore, new claims 37-39 (*e.g.*, incorporation of features of dependent claims into the independent claims) were submitted in Response to the Final Office Action. However, the Examiner refused entry of the amendments. *See*, Advisory Action.

Summary of the Claimed Subject Matter

The claimed subject matter recites methods for producing improved copolymerized products. Such methods include copolymerizing at least one vinylaromatic monomer with at least one diene polymer in the presence of at least one multifunctional initiator. *See*, specification, at least paragraph 9. A balance of several characteristics, including average molecular weight, molecular weight distribution, melt flow index and storage modulus, is generally required to produce copolymerized products, such as polystyrene, suitable for a particular application. Further, the suitability of one particular copolymerized product, High Impact Polystyrene (HIPS), depends on the rubber morphology, which is influenced by rubber particle size, rubber particle size distribution, swell index, grafting and the rubber phase volume (measured by the gel to rubber ratio), for example. *See*, specification, at least paragraph 2.

The claimed methods further include recovering a copolymerized product, such as polystyrene, having a ratio of % gel to % rubber that increases as swell index increases. *See*, specification, at least paragraph 9. The gel to rubber ratio generally represents the rubber efficiency of a process, *i.e.*, how much rubber must be used to obtain similar

product quality. Commercial HIPS materials generally result in a (G/R) that decreases as the swell index increases. See, specification, at least paragraph 20.

Unexpectedly, it has been discovered that utilizing trifunctional and tetrafunctional initiators, such as peroxides, in the HIPS process results in a trend that is contrary to conventional HIPS resins, *i.e.*, an increasing G/R with an increasing swell index. See, specification, at least paragraph 21. Such a trend result in higher production rates with the ability to maintain molecular weights and improved rubber phase volumes, for example. See, specification, at least paragraph 25.

Grounds of Rejection to be Reviewed on Appeal

1. The rejection of claims 1-36 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,433,092, U.S. Patent No. 6,166,099, U.S. Patent No. 6,274,641, U.S. Patent No. 6,420,444 or U.S. Patent No. 6,608,141 (collectively referred to as *Krupinski*).

Arguments

I. THE EXAMINER ERRED IN REJECTING CLAIMS 1-36 UNDER 35 U.S.C. §103(a) AS BEING UNPATENTABLE OVER *KRUPINSKI* BECAUSE *KRUPINSKI* DOES NOT TEACH, SHOW OR SUGGEST A COPOLYMERIZED PRODUCT HAVING A G/R THAT INCREASES AS SWELL INDEX INCREASES.

Applicants personally interviewed the pending claims with the Examiner on January 12th, 2005, where the Examiner concurred with the Applicants' argument that the process and resin of *Krupinski* are not identical to the process and resins claimed. However, the Examiner issued a Final Rejection on April 18, 2005.

In finally rejecting the claims, the Examiner submits the ratio of % gel to % rubber can be within the range specified in the present claims. See, Advisory Action. Applicants disagree that *Krupinski* teaches, shows or suggests a % gel to % rubber (G/R) that increases as the swell index increases.

The prior art reference must teach or suggest all of the limitations of the claims. See, *In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970.) As previously stated, *Krupinski* does not teach or suggest a ratio of % gel to % rubber (G/R) that increases as swell index increases, as recited in the pending claims.

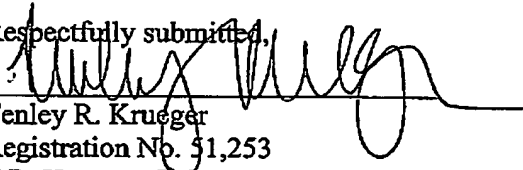
The Examiner further states that there are no process conditions for producing the improved HIPS and that all references to *Krupinski* disclose a process for making HIPS using a tetrafunctional peroxide. See, Advisory Action. The process conditions are clearly recited in the pending claims (e.g., copolymerizing at least one vinylaromatic monomer with at least one diene polymer in the presence of at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides.)

Further, that which is inherent in the prior art, if not known at the time of the invention, cannot form a proper basis for rejecting the claimed invention as obvious under Section 103. See, *In re Shetty*, 566 F.2d 81, 86, 195 U.S.P.Q. 753, 756-57 (C.C.P.A. 1977.) The test of obviousness is statutory, rather than dictated by case law. See, *In re Ochiai*, 71 F.3d at 1569, 37 U.S.P.Q.2d at 1131. It would not have been obvious to those of ordinary skill in the art to choose trifunctional and tetrafunctional peroxides to produce a copolymerized product having a G/R that increases as swell index increases. Such an effect (e.g., G/R increasing as swell index increases) was not known and in fact the contrary was believed. See, *Impact Polystyrene: Factors Controlling the Rubber Efficiency*, E.R. Wagner and L.M. Robeson, Rubber Chem. Tech., Vol. 43, pp 1129-1137, at 1131-1132 and 1135-1136 and U.S. Patent No. 6,703,460 (*Blackmon*) at Table III. Accordingly, Applicants respectfully request reversal of the rejection.

Conclusion

In conclusion, *Krupinski* nowhere teaches or suggests recovering a copolymerized product that has a ratio of % gel to % rubber (G/R) that increases as swell index increases, such as recited in the pending claims. Thus, Applicants respectfully request reversal of the rejections of claims 1-36.

Respectfully submitted,



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Appendix A

Pending Claims

1. A method for producing an improved copolymerized product comprising:
copolymerizing at least one vinylaromatic monomer with at least one diene polymer in the presence of at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides, and
recovering a copolymerized product that has a ratio of % gel to % rubber (G/R) that increases as swell index increases.
2. The method of claim 1 where the copolymerized product has a melt flow index (MFI) ranging from about 2 to about 7.
3. The method of claim 1 where the G/R increases from about 1 to about 4 as the swell index increases from about 8 to about 20.
4. The method of claim 1 where in copolymerizing the monomer, the vinylaromatic monomer is styrene.
5. The method of claim 1 where in copolymerizing the monomer, the multifunctional initiator is selected from the group consisting of tri- or tetrakis t-alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy) butane, tri- or tetrakis (t-amylperoxycarbonyloxy) butane and tri- or tetrakis (t-C₄₋₆ alkyl monoperoxycarbonates), and mixtures thereof.
6. The method of claim 1 where the copolymerized product is more highly branched as compared with a polymerized product made by an otherwise identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.
7. The method of claim 1 where the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.

8. The method of claim 1 where in copolymerizing the monomer, the polymerizing is conducted at a temperature between about 110°C and about 180°C.
9. The method of claim 1 where the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.
10. The method of claim 1 where in recovering the product, the copolymerized product is high impact polystyrene (HIPS).
11. The method of claim 1 where the polymerization rate ranges from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.
12. The method of claim 1 where the polydispersity of the copolymerized product ranges from about 2.3 to about 4.0.
13. An improved copolymerized product made by the process comprising:
copolymerizing at least one vinylaromatic monomer with at least one diene polymer in the presence of at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides, and
recovering a copolymerized product that has a ratio of % gel to % rubber (G/R) that increases as swell index increases.
14. The copolymerized product of claim 13 where the copolymerized product has a melt flow index (MFI) ranging from about 2 to about 7.
15. The copolymerized product of claim 13 where the G/R increases from about 1 to about 4 as the swell index increases from about 8 to about 20.
16. The copolymerized product of claim 13 where in copolymerizing the monomer, the vinylaromatic monomer is styrene.

17. The copolymerized product of claim 13 where in copolymerizing the monomer, the multifunctional initiator is selected from the group consisting of tri- or tetrakis t-alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy) butane, tri- or tetrakis (t-amylperoxycarbonyloxy) butane and tri- or tetrakis (t-C₄₋₆ alkyl monoperoxycarbonates), and mixtures thereof.

18. The copolymerized product of claim 13 where in recovering the copolymerized product, the product is more highly branched as compared with a polymerized product made by an otherwise identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.

19. The copolymerized product of claim 13 where in the copolymerizing the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.

20. The copolymerized product of claim 13 where in the copolymerizing the polymerization rate ranges from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.

21. The copolymerized product of claim 13 where the polydispersity of the copolymerized product ranges from about 2.3 to about 4.0.

22. The copolymerized product of claim 13 where in copolymerizing the monomer, the polymerizing is conducted at a temperature between about 110°C and about 180°C.

23. The copolymerized product of claim 13 where in copolymerizing the monomer, the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.

24. The copolymerized product of claim 13 where in recovering the product, the polymerized product is high impact polystyrene (HIPS).
25. An article made with the vinylaromatic/diene graft copolymer of claim 13.
26. A resin comprising:
at least one vinylaromatic monomer;
at least one diene polymer;
at least one multifunctional initiator selected from the group consisting of trifunctional and tetrafunctional peroxides, where the amount of multifunctional initiator is sufficient to produce a copolymerized product that has a % gel to % rubber (G/R) ratio that increases as swell index increases.
27. The resin of claim 26 where the amount of multifunctional initiator is sufficient to polymerize the vinylaromatic monomer at a rate of from about 2 to 7 times that of styrene polymerized thermally in the absence of initiator.
28. The resin of claim 26 where the amount of multifunctional initiator is sufficient to produce a copolymerized product having a polydispersity ranging from about 2.3 to about 4.0.
29. The resin of claim 26 where the amount of multifunctional initiator is sufficient to produce a copolymerized product that has a melt flow index (MFI) ranging from about 2 to about 7.
30. The resin of claim 26 where the G/R increases from about 1 to about 4 as the swell index of the product made therefrom increases from about 8 to about 20.
31. (Original) The resin of claim 26 where the vinylaromatic monomer is styrene.

32. The resin of claim 26 where the multifunctional initiator is selected from the group consisting of tri- or tetrakis t-alkylperoxycarbonates, tri- or tetrakis (polyether peroxycarbonate), tri- or tetrakis-(t-butylperoxycarbonyloxy) methane, tri- or tetrakis-(t-butylperoxycarbonyloxy) butane, tri- or tetrakis (t-amylperoxycarbonyloxy) butane and tri- or tetrakis (t-C₄₋₆ alkyl monoperoxycarbonates), and mixtures thereof.

33. The resin of claim 26 where the copolymerized product made therefrom is more highly branched as compared with a polymerized product made by an otherwise identical method except that a multifunctional initiator replaces at least a portion of a difunctional initiator.

34. The resin of claim 26 where in the multifunctional initiator is present in an amount ranging from about 50 to about 1200 ppm, based on the vinylaromatic monomer.

35. The resin of claim 26 where the weight ratio of vinylaromatic monomer to diene polymer ranges from about 97:3 to about 85:15.

36. An article made from the resin of claim 26.

Appendix B

Evidence

1. *In re Wilson*, 424 F.2d 1382, 165 U.S.P.Q. 494 (C.C.P.A. 1970.)
2. *In re Shetty*, 566 F.2d 81, 195 U.S.P.Q. 753 (C.C.P.A. 1977.)
3. *In re Ochiai*, 71 F.3d 569, 37 U.S.P.Q.2d 1131.
4. *Impact Polystyrene: Factors Controlling the Rubber Efficiency*, E.R. Wagner and L.M. Robeson, Rubber Chem. Tech., Vol. 43, pp 1129-1137.
5. U.S. Patent No. 6,703,460.

Appendix C
Related Proceedings

Not Applicable

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